A.D. 1864, *28th December.* N° 3227.

Signalling in Railway Trains.

LETTERS PATENT to William Henry Preece, Civil Engineer, and Alfred Bedborough, Architect, both of the Town and County of Southampton, for the Invention of "IMPROVED APPARATUS FOR SIGNALLING IN RAILWAY TRAINS."

Sealed the 13th June 1865, and dated the 28th December 1864.

PROVISIONAL SPECIFICATION left by the said William Henry Preece and Alfred Bedborough at the Office of the Commissioners of Patents, with their Petition, on the 28th December 1864.

We, WILLIAM HENRY PREECE, Civil Engineer, and ALFRED BEDBOROUGH, Architect, both of the Town and County of Southampton, do hereby declare the nature of the said Invention for "IMPROVED APPARATUS FOR SIGNALLING IN RAILWAY TRAINS," to be as follows:—

These improvements relate to a new and simple method of raising an alarm in the guard's van or upon the engine from the interior and exterior of any or every carriage in a railway train, and of indicating the particular carriage from whence the communication has been made, and of affording instant intimation of the rupture of any coupling or breaking away of any part of the train.

In carrying out our improvements electricity is made to sound an alarum, and mechanical force is applied to indicate the source of danger. An ordinary trembling bell worked by electric currents is fixed in the van or

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upon the engine, but the means for operating it are so arranged that the oscillation of the train shall have no action upon the hammer except when attention is required to be called to the signal apparatus. To keep the hammer clear of the bell a rocking step bar is used; this bar forms the armature of a second magnet (separate from that which works the hammer,) and by the second magnet rocking this bar the hammer will be free to approach the bell under the influence of its electro-magnet. The battery for supplying currents of electricity to the electro-magnets is fixed in the van, and may be of any of the well-known ordinary forms of constant batteries. Two wires traverse the whole train, passing beneath each carriage, whose electrical connection is maintained by hook-and-eye couplings of peculiar construction; each length of wire is connected at one end to a hook and another to an eye or ring. The hook is hinged to a metal plate on the carriage frame, and its shank is attached to a stout helical spring which maintains it when not coupled up in hard contact against a metal stud; the eye or ring forming one termination of the coupling wire of one carriage when slipped over the hook of the adjacent carriage frees it from this metal stud. The eye attached to the end of the wire of one carriage being thus brought into metallic contact with the hook on the end of the wire of the adjacent carriage, and the same arrangement being continued throughout the train, an electric circuit is formed through all the coupled carriages. The metal stud is placed in connection with the earth through the wheels of the carriage and the rails. When the ring or eye is forced off the hook either by the breaking away of a portion of the train through the failure of the ordinary couplings, or by the act of the guard or other person in charge of the train, in the manner to be presently explained, the bell immediately rings in the van and on the engine.

A branch from each of the two wires that traverse the train is carried into each compartment of every carriage, and by their connection either by ordinary commutators or by the falling of the indicator, to be presently described, an electric circuit is formed which rings the bell in the guard's van only. The indicator that is used to distinguish the particular compartment that requires attention is an ordinary semaphore arm which is maintained in its normal position by a catch or detent retained firm and immoveable from the oscillation of the train by a helical or flat spring. The fulcrum upon which this semaphore arm works is placed at its lower extremity, and as the catch holds it out of the perpendicular, it necessarily follows that when the catch is raised the semaphore falls by its own gravity into a horizontal position; it can only be restored to its normal position by operating upon it

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by manual force from the exterior of the carriage. The semaphore as it falls completes an electric circuit which rings the bell in the van, and it will continue to do so incessantly until, in fact, the semaphore is restored to its normal position by the guard or conductor of the train. The catch or detent can be released by ordinary bell pulls or ropes pendent in the carriage, and arranged to act upon pullies or cranks of ordinary construction, but inasmuch as railway companies fear to place such ready means of raising an alarm within the reach of timid, thoughtless, and nervous passengers, a "releaser" of peculiar construction is adopted. The wire attached to the catch of the semaphore arm running around a small pulley is attached to a rod working in a cylinder; in the interior of this cylinder is a stout spiral spring which is intended to act upon the rod with sufficient force to release the catch. The cylinder with its spring and piston rod is placed in a case having a hinged face or cover with a lock and key and a circular orifice that is glazed or filled with some fragile material. When the cover is closed and locked the glass or other fragile material bears against the head of the rod, forcing back the spring and allowing the catch to lock the semaphore arm. By fracturing the glass either by the blow of a stick or other hard material the rod is released, and the spring being now free to act, will release the catch and allow the semaphore to fall. The electric circuit being now complete the alarm will be sounded, and the bell will continue to ring until the semaphore arm is restored; this will require the glass face to be renewed in order that the rod may be forced back into its original position.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said William Henry Preece and Alfred Bedborough in the Great Seal Patent Office on the 28th June 1865.

TO ALL TO WHOM THESE PRESENTS SHALL COME, we, WILLIAM HENRY PREECE, Civil Engineer, and ALFRED BEDBOROUGH, Architect, both of the Town and County of Southampton, send greeting.

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Twenty-eighth day of December, in the year of our Lord One thousand eight hundred and sixty-four, in the twenty-eighth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto us, the said William Henry Preece and Alfred Bedborough, Her special licence that I, the said William Henry Preece and Alfred Bedborough, our executors, administrators, and assigns, or such others as we, the said William Henry

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Preece and Alfred Bedborough, our executors, administrators, and assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "IMPROVED APPARATUS FOR SIGNALLING IN RAILWAY TRAINS," upon the condition (amongst others) that we, the said William Henry Preece and Alfred Bedborough, our executors or administrators, by an instrument in writing under our, or their, or one of their hands and seals, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

NOW KNOW YE, that I, the said William Henry Preece, on behalf of myself and of the said Alfred Bedborough, do hereby declare the nature of our said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement, reference being had to the Drawings hereunto annexed, and to the letters and figures marked thereon (that is to say) :—

These improvements relate to a new and simple method of communicating signals to the guard or guards of a railway train or to the engine driver from any carriage, or it may be any compartment of the carriages composing the train, and of indicating at the same time the particular carriage from whence the communication has been made. By our improvements intimation of the rupture of any coupling or the breaking away of any part of the train is also instantly afforded to the guards and engine driver, the action of the apparatus in that case being automatic.

In carrying out our Invention we employ electric currents obtained from suitable batteries for operating an ordinary trembling bell mounted on the engine tender, and in every guard's van in the train. The passenger carriages we fit at each side with semaphore signals which will fall by their own gravity, and thereby indicate whence the signal, if it be one transmitted by a passenger, has emanated.

In the accompanying Drawings Fig. 1, Sheet I., shews a Diagram of a railway train coupled electrically according to this Invention; and Figures 2, 3, 4, and 5, shew the construction of the couplings for bringing all the carriages of the train within the same electric circuit.

In Sheet II., Fig. 1 shews in transverse section a railway carriage fitted with semaphore signals and apparatus for releasing the same, and simul-

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taneously connecting the line wire with the earth, and thereby setting the alarm bells of the train in action. Fig. 2 is a partial cross section shewing a semaphore released; Fig. 3 is a sectional plan on an enlarged scale of the apparatus for effecting the release of the semaphores, and Fig. 4 is a front view of the same. The alarum or trembling bell is shewn at Fig. 5 as worked by an electro-magnetic apparatus. A bell is fixed in the guard's vans and also upon the engine tender, with the means for operating it so arranged that the oscillation of the train shall have no action upon the hammer except when attention is required to be called to the signal apparatus.

a (Fig. 5) is the hammer mounted on the end of an armature *b*, which when attracted by an electro-magnet *c* has a tendancy to strike the bell *d*. In order, however, to keep the hammer clear of the bell, a rocking stop bar *e* is used. This bar forms the armature of a second magnet *f*, and by the second magnet rocking this bar, the hammer will be free to approach the bell under the influence of its electro-magnet. The batteries for supplying currents of electricity to the electro-magnetic apparatus are fixed in the tender or guard's carriage, and may be of any of the well-known ordinary forms of constant batteries. These batteries are coupled with their respective electro-magnets in the usual way, and have a wire to earth, as shewn by blue lines in the Diagram, Fig. 1, Sheet I. The current passing from the positive pole of the battery enters the electro-magnetic apparatus, Fig. 5, Sheet II., by the wire 1, and passes thence along the spring 2 to the armature *b*, whence it flows into the coil of the electro-magnet *c*. While the spring 2 and armature *b* are in contact, the current passes by a coupling wire 3 to the electro-magnet *f*, and thence by the wire 4 to the line wire 5, which extends under all the carriages of the train, as indicated by the red line, Fig. 1, Sheet I. Whenever this line wire is brought into connection with the earth by the means that will be presently explained, the magnet *f* will draw down its armature, and thereby release the armature *b*, which will then under the attraction of its magnet advance and cause the hammer to strike the bell. The rebound of the hammer will enable the armature *e* to fall and arrest the return motion of the armature *b* until the magnet *f* under the renewed current again attracts its armature, and allows a repetition of the blow. It will be thus understood that the mere oscillations of the train will have no action on the bell. The portions of the line wire with which the several carriages are fitted are maintained in electrical connection by the hook-and-eye couplings to which their extremities are attached, as shewn in side section at Fig. 2, and in front view at Fig. 3, Sheet I.

For the purpose of making the arrangement clear it may be stated that

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each length of wire 5 (Fig. 1) is permanently connected at one end to a hook A, and at the other to an eye or ring B. The hook is hinged to a metal plate A^1 at the end of the carriage frame, and its shank is fitted to receive a stout helical spring A^2, which spring is secured at one end to the shank, and at the other to the fulcrum pin, in such a manner as to maintain the hook when not coupled up in hard contact against a metal stud C fixed in the carriage framing, and communicating by means of a wire 6 with the earth. The eye or ring B forming the termination of the coupling wire of the adjoining carriage is intended to be slipped over the hook A, as shewn. This eye or ring is attached to a flexible portion of the line wire, the wire being in fact enveloped in a cord which is secured by a clamping plate (shewn in section and face views at Figures 4 and 5) to the end of the carriage. When the eye of this flexible cord is slipped over the hook A, that hook is freed from contact with the metal stud C. The eye attached to the end of the wire of one carriage being thus brought into metallic contact with the hook on the end of the wire of the adjacent carriage, and the same arrangement being continued throughout the train a continuous line wire is formed extending from the engine or tender to the last coupled carriage. The metal stud C, it will be understood, is placed in connection with the earth through the wheels of the carriage and the rails. When the ring or eye is forced off the hook by the breaking away of a portion of the train through the failure of the ordinary couplings, the bells in the guard's van and on the engine will immediately sound.

Branches from the line wire or the wire that traverses the train are carried up into the several compartments of each carriage as indicated by the Diagram, Fig. 1, Sheet I., and more fully shewn at Fig. 1, Sheet II., and connected to a spring contact maker, which on the falling of the indicator to be presently described, completes an electric circuit which rings the bell in the guard's van only. The indicator used for distinguishing the particular compartment that requires attention is an ordinary semaphore arm *g*, Figures 1 and 2. This arm is maintained in its normal or upright position within a recess formed for it in the side framing of the carriage by a hooked bell-crank lever *h*, which catches on to a pin projecting from the face of the semaphore; g^1 is a fulcrum pin upon this semaphore arm is fixed. It passes through the lower extremity of the arm, and is free to turn in metal bearings to which the earth wire 6 is attached; a cam or projection on this pin g^1 strikes on the fall of the semaphore the spring contact maker *i*, as shewn at Fig. 2, and completes the circuit. The semaphore is so mounted that when released from the catch it will fall by its own gravity into a horizontal

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position, and thus indicate the compartment whence the signal was given. It can only be restored to its normal position by operating upon it by manual force from the exterior of the carriage. The semaphore in falling completes an electric circuit, and sets the electro-magnetic apparatus before described in action, which continues to ring the bell in the guard's van until in fact the semaphore is restored to its normal position by the guard or conductor of the train. The catch h might be released by an ordinary bell pull or rope pendent in the carriage, and arranged to act upon pulleys or cranks of ordinary construction, but inasmuch as railway companies fear to place such ready means of raising an alarm within the reach of timid, thoughtless, and nervous passengers a "releaser" of peculiar construction is adopted. The construction of this release is clearly shewn in the sectional plan view, Fig. 3, Sheet II. It consists of a cylindrical box containing a jointed frame k, to which on either side one end of a rod h^1 is secured, its other end being jointed to the catch h of the semaphore arm. This jointed lever frame k contracts laterally under internal pressure for the purpose of drawing the rods h^1 inwards sufficiently to disengage their catches from the semaphore arms. In carrying out this part of the Invention we mount the "releaser" in the partition that divides the compartments of the carriage and give its box two faces that it may serve for two compartments. Both sides of the carriages are provided with semaphores, and therefore the rods h^1 for operating the catches h are in duplicate for each "releaser." In the centre of the lever frame k is a cylinder k^1 containing a stout coiled spring k^2. This spring is placed between a pair of pistons k^3, which are fitted with rods that pass through the ends of the cylindrical box, and this spring is made of sufficient force to enable it to act upon the rods h^1 and release the catches which hold the semaphores in their elevated position. Fitted to the ends of the cylindrical box are glazed covers which may be secured in place by hinges, and a lock and key, or otherwise. The glass may conveniently have printed upon it the notice shewn at Fig. 4. When the glazed covers are closed and locked they will bear against the head or ends of the piston rods, and forcing back the pistons will compress the spring, as shewn at Fig. 3, and allow the catches to lock the semaphore arms. By simply fracturing the glass by one of the covers, either by the blow of a stick or other hard material, one of the rods is released, and the spring being now free to act will contract the frame K laterally sufficient to draw back the rod h^1 and release the catch, and allow the semaphore to fall. The electric circuit being now complete the suspended current will pass from the nearest battery to the electro-magnetic apparatus in connection therewith, and set the alarum in action. The current will then flow along the line wire to earth and

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continue sounding the alarum bell until the semaphore arm is restored to its raised position. In order to reinstate the apparatus the glass face must be renewed, and the piston rod forced back into its original position.

To enable the carriages to be coupled up either end foremost we make lateral circuit branches from the line wire at each end of each section of that wire, and fit the duplicated ends of the line wire of each carriage with a hook A and an eye B, Sheet I. In case of a coupling giving way the eyes B of the uncoupled carriages will be drawn off the hooks A, and the latter will by their coiled springs be pressed into contact with their studs C, which studs are in electric connection with the earth. Electric circuits will thus be completed in the severed portions of the train, and the alarums will be simultaneously set in action, thus instantly warning both the guard and engine driver of the occurrence of the accident.

Having now set forth the nature of our Invention of "Improved Apparatus for Signalling in Railway Trains," and explained the manner of carrying the same into effect, we wish it to be understood that under the above in part recited Letters Patent, we claim,—

First, the combination of semaphore and audible signal apparatus acting automatically together, or the audible signal alone, in the manner and for the purpose above set forth.

Secondly, the glass protector for securing the apparatus from being tampered with and yet admitting of its being readily set in action as explained when occasion requires.

In witness whereof, I, the said William Henry Preece, have hereunto set my hand and seal, the Twenty-eighth day of June, in the year of our Lord One thousand eight hundred and sixty-five.

W. H. PREECE. (L.S.)

Witness,

J. W. MOFFATT,

66, Chancery Lane.

LONDON:
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Printers to the Queen's most Excellent Majesty. 1865.

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FIG. 2.

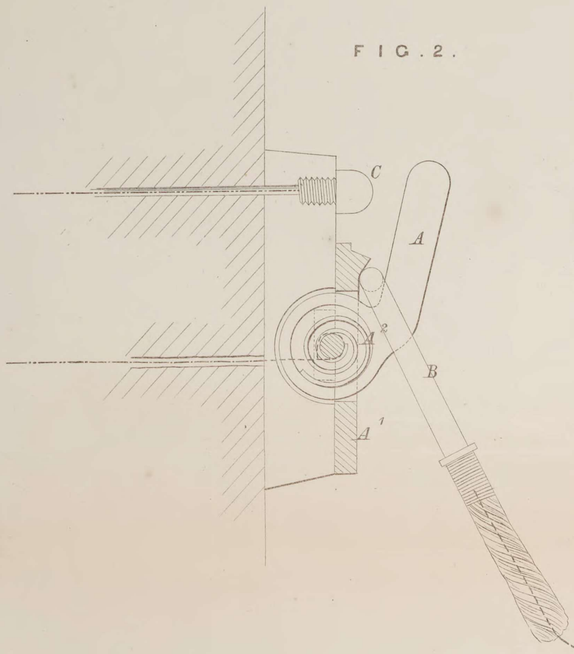


FIG. 3.

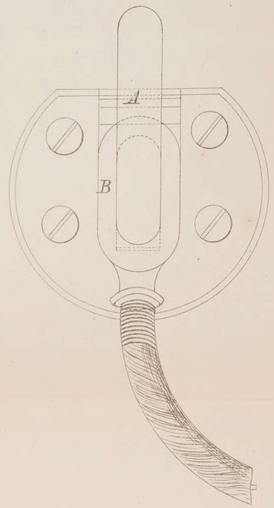


FIG. 4.

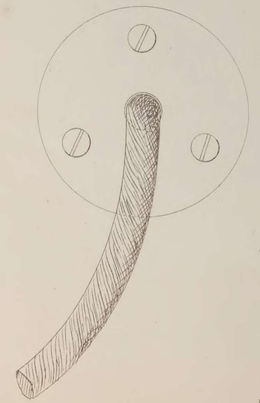


FIG. 5.

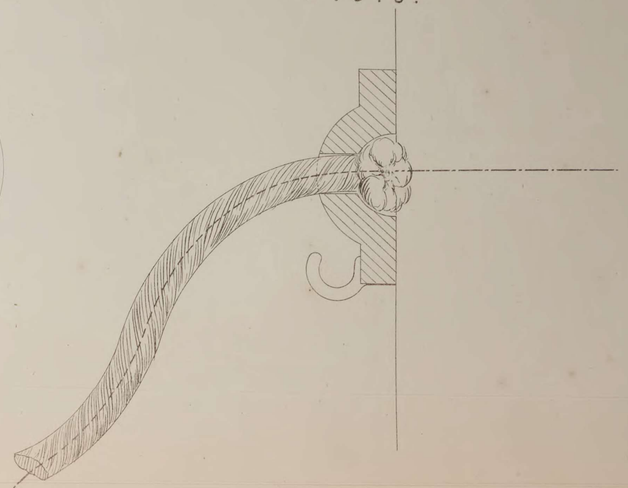
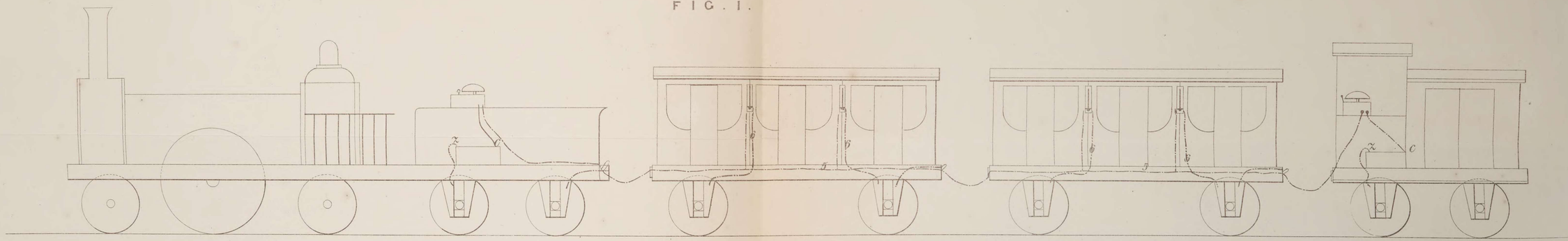


FIG. 1.



The filed drawing is partly colored.

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A.D. 1864, Dec. 28, N°3227.
PREECE & BEDBOROUGHS Specification.

(2 SHEETS)
SHEET 2.

FIG. 1.

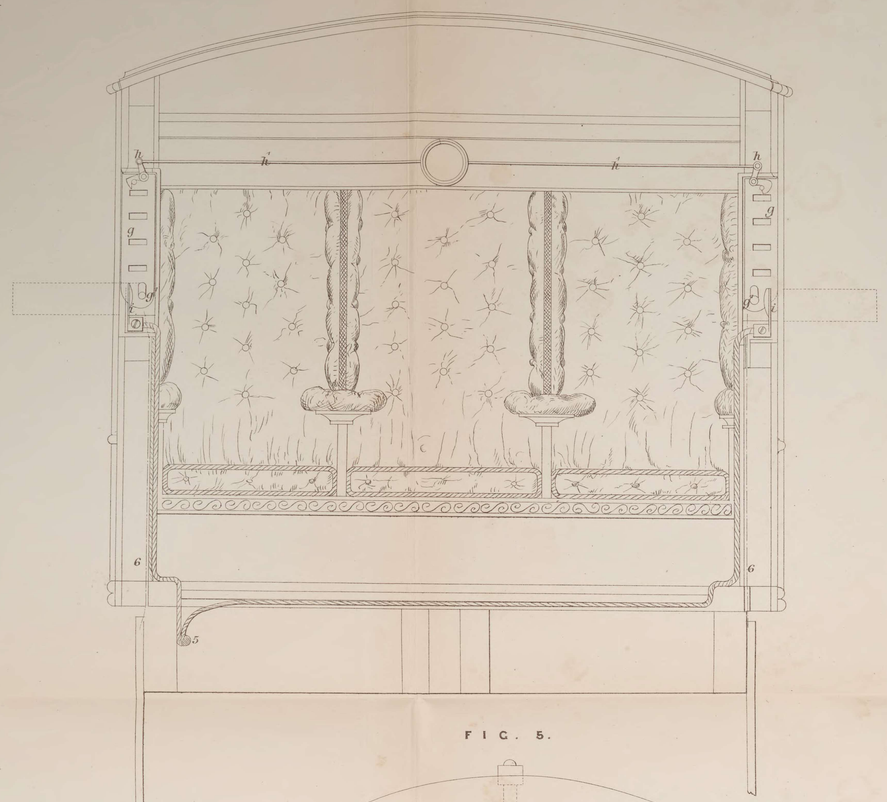


FIG. 2.

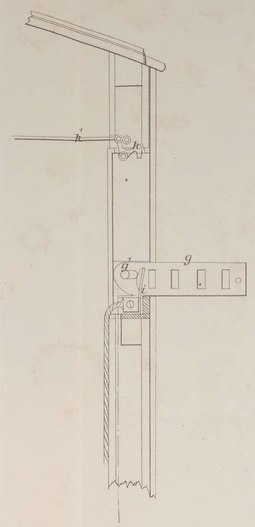


FIG. 3.

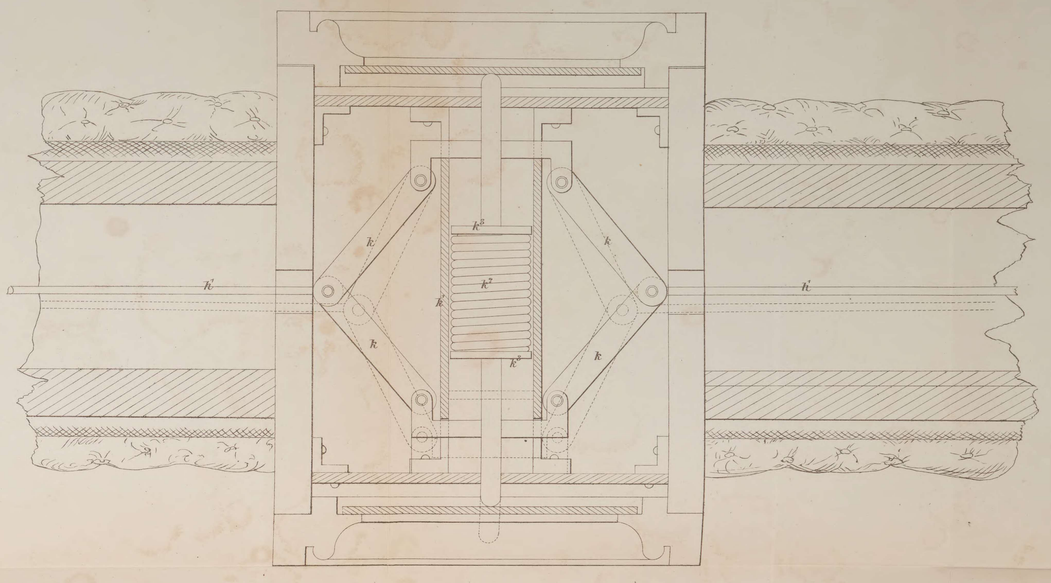


FIG. 5.

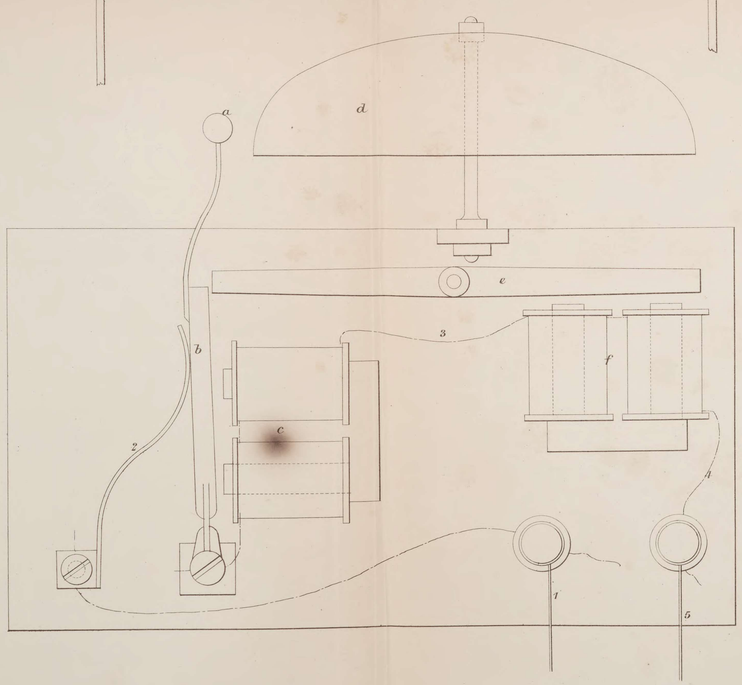
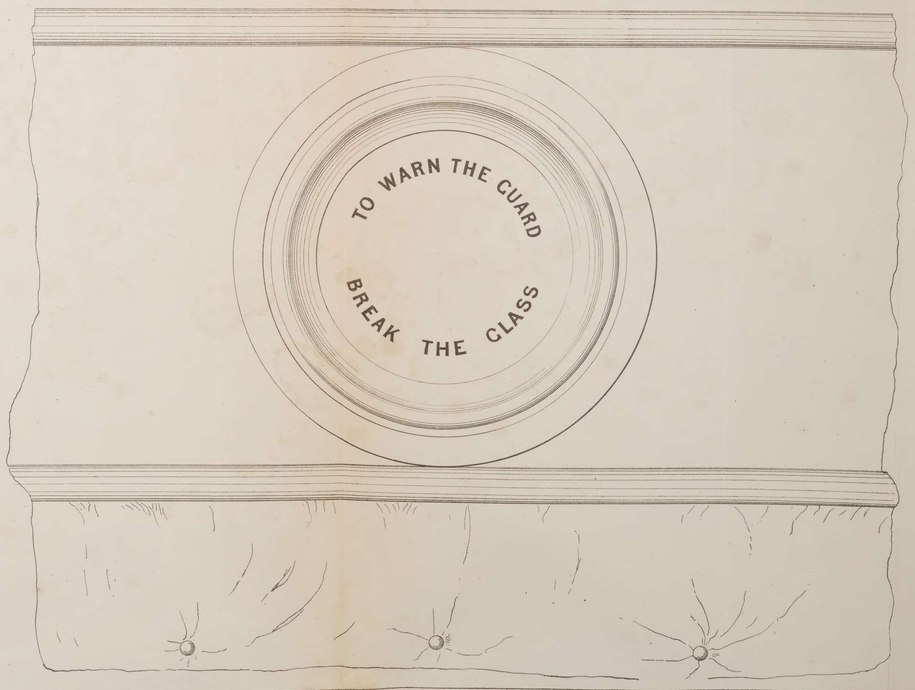


FIG. 4.



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